RESEARCH NOTES

January 2008

Sand-Jack Design and Capacity for Bridge Construction

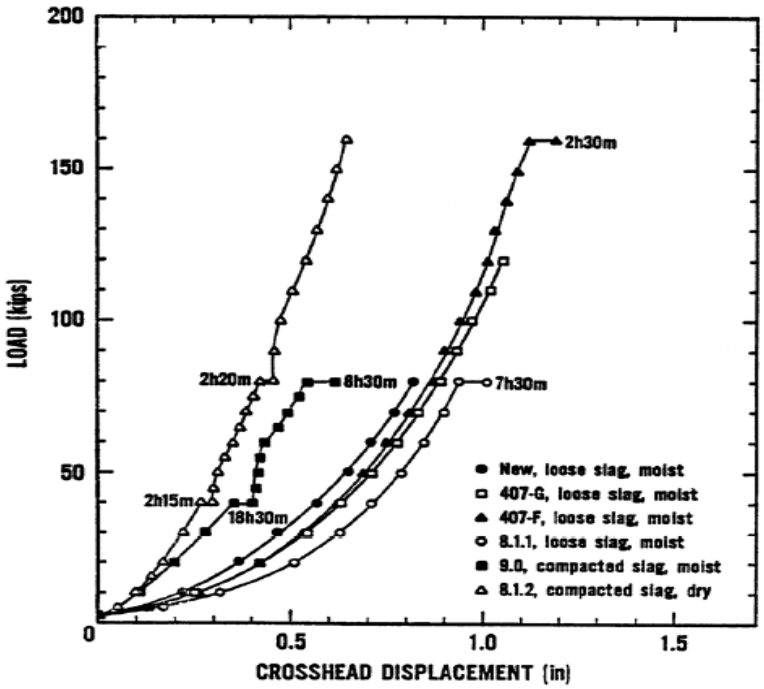
RESULTS: ***In the erection of cast-in-place concrete bridges, sand-jacks are used to assist the removal of Falsework. The result from research provides guidance to field engineers in determining which sand-jacks are acceptable in construction. Research has shown that banding the sand-jack increases the capacity substantially. The allowable capacities are 50 kips, 55 kips, 60 kips for 1, 2 and 3 bands respectively. These results will ultimately be incorporated into Caltran's Falsework manual and lead to improving construction worker safety.***

Background

A sand-jack is a sand-filled containment frame of steel or wood, generally used as a common component for bridge Falsework to temporarily support girder segments during construction. The load from the structure transfers directly on a timber "plunger," or bearing plate, which in turn is supported on the sand bed. The sand jack is essential since, after the girders and the decks are placed, the Falsework is jammed tightly under the structure and is therefore extremely difficult to remove. Using sand jack allows the sand to be removed, thus allowing the timber plunger or the bearing plate to drop, and thereby removing the support from beneath the structure. Then, the Falsework can be easily dissembled.

Why We Pursued This Research

There are no standards of design and capacity for sand-jacks, resulting in significant variance during practice. Construction accidents have brought attention to the design and use of sand-jacks in bridge construction. In 1982, a collapse resulting in sixteen fatalities occurred at the Riley Road Interchange Ramp in East Chicago, Indiana. Both Occupational Safety and Health Administration (OSHA) and the U.S. Department of Transportation conducted an investigation involving National Bureau of Standards (NBS). Tests conducted by NBS resulted in load deflection curves up to approx. 170 kips as shown in the following figure.



From these previous investigations, it can be seen that in order to determine failure modes and ultimate capacities, test setup must be capable of generating very large vertical loads.

Reducing Change Orders in the field as a result of research will save Caltrans funds. The guidance the research provides will give field engineers the ability to approve or disapprove a contractor's request to use higher capacity sand-jacks.

What We Did

Office of Earthquake Engineering from Engineering Service Center contracted with University of California, San Diego to research on sand-jacks in determining ultimate capacity. Forty-six (46) sand-jacks were constructed and tested to failure. Specimens were varied by sand filler type, number of bands, number of crimps per band, band location, annular gap, with or without corbels, with or without Visqeen liner, nailing configuration and number of nails.

Research Results

The following conclusions are drawn from the results:

- In displacements less than 1-inch, the difference in wood sand-jack stiffness with one, two, or three bands is small.
- Using no banding on a wood sand-jack reduces the stiffness by 50%.
- Ultimate capacity is significantly increase by using more bands.
- Increasing crimp connectors on each band will raise the ultimate capacity with no affect on response stiffness.
- Placing one band at the middle or lower third of the sand-jack has minor affect on capacity or stiffness.
- Closely-spaced base nails increase the stiffness and capacity, but not at displacements less than one inch.
- Using a Visqueen liner appears to have no advantage.
- Although the bearing area is less than 12 inches, performance does not change in placing a 15-inch sand-jack box on a 12-inch corbel with squared corners.
- The 30 mesh sand had a stiffer response than the #16 sand when use with the steel cylinder.
- Less displacement results from a larger plunger or smaller annular gap in tests with the steel cylinder.

Recommendations

Each sand-jack box should be nailed together with 2x6 Douglas Fir #2 or better using a 1/2“CDX plywood plunger and base. Filler material should be type 30 mesh sand and all nails to be 16d, 3 at the corners and 2 on each side.

Reference

Paul Travis Sanders, Scott A. Ashford; “Full Scale Load Testing of Sand-Jacks”, Final Report, June 2006.

U.S. Department of Transportation & Federal Highway Administration, (1982). Investigation of Construction Failure of the Riley Road Interchange Ramp, East Chicago, Indiana NBSIR 82-2593, U.S. Department Of Transportation & Federal Highway Administration, Washington, DC.